# Proficy Plant Applications 2022

Handling Production

We want to hear from you. If you have any comments, questions, or suggestions about our documentation, send them to the following email address:

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# Introduction to Production Management

Production Management ties your plant operations together by exchanging key production and status information with your customers and your internal business systems, as well as between your plant processes.

Production Management works between your control systems and planning systems. It gives the ability to track a product from raw material to your customer's hands, to manage in-process inventory, to control the flow of a product in a multi-step process, send recipes to the control system, and track production against a schedule. Production Management can tell you exactly what is going on in your production processes at any given time, helping you eliminate static on the line.

- Manufacturers produce product and consume raw materials by some discrete unit such as a Batch, Reel, Lot, Skid, Pallet, Tote, and Serial Number.

- Manufacturers have multiple steps in their production processes and an example of that is in the paper industry. Pulping – Paper Making – Finishing – Converting.

- Manufacturers need to provide traceability across multiple steps for Product recall, customer certificate of analysis, FDA regulations, and quality improvements.

- Manufacturers produce product according to a schedule to make to an order or make to build current inventories.

**When is Production Management Needed?**

Production Management is needed if there is a need to:

- Model a multi-step process

- Track the Genealogy of a product through a multi-step process

- Track raw materials

- Barcode product

- Accept and control a schedule

- Track Production against a schedule

- Associate Quality and Process data to customers

**Production Management Features**

- Model and controls the flow of product from unit to unit through various paths among production equipment

- Automatically drives product movement and genealogy from control system data

- Captures production information at each unit manually or automatically from control system data

- Captures consumption information at each unit manually or automatically from control system data and through calculations

- Monitors key performance indicators of efficiency and production across the plant

- Accepts a schedule and controls production around that schedule

- Accepts customer, order, and shipment information for manufactured product

- Handles the special requirements needed to schedule and track dimensional product

- Attaches production identification to orders

- Controls and reports orders

- Automatically prints and scans bar codes

- Manually drives product movement

- Manages and reports in-process inventories

- Creates ad-hoc reports on production, schedule, and genealogy issues

- Creates Certificates of Analysis for customers (This is an Applied Solution available from our Professional Services Group. Please call 1-800-GEFanuc for more details.)

- Publishes inventory, production, schedule and genealogy information to the web

- Supports ActiveX controls for rapid deployment of solutions in any ActiveX container

# Production Management Configuration Process

Steps in this topic present an overview of steps to configure production management. For long production events, it may be desirable to monitor event progress. Refer to Periodic Event Dimension Update.

1. Plant Model Overview

2. Configure Placeholder Production Events

3. Adding and Defining Production Statuses

4. Define Production Unit Properties for each Production Unit

    a. Unit Type.

    b. Select Production Statuses for each Unit.

    c. Define the valid transitions from one Production Status to another for each Unit.

    d. Set Production Metrics for Downtime, Efficiency, Production, and Waste.

    e. Define Inventory Locations if Unit Type of Inventory is used.

    f. Define the Raw Material Inputs for each Unit.

    g. For each Raw Material Input, determine if Events can be consumed on multiple Units at the same time.  If not set the Lock Materials During Consumption.

    h. For each Raw Material Input, set up Bill of Material Control Filtering if required.

    i. For each Raw Material Input, define the Production Units that can feed into each Input.  These Units make up the Valid Input Sources.

    j. For each Raw Material Input Production Unit feed, define the Valid Input statuses that can be fed into this Input for those Units defined as Valid Input Sources to the Input.

    k. [Determine Events to be used](#).  Research the automation and signals available to trigger production events, product movement, and production tracking and by selecting and configuring the following required Models:

    o Production Event Models
    o Movement Models
    o Genealogy Model
    o Consumption Models
    o Schedule Change Models

5. Build the Production Execution Paths

    a. Set Path Name and Path Code.

    b. Enable Line Production Counting if required for reporting purposes.

    c.   Enable creation of Child Orders if required to split and run Orders on multiple paths at the same time.

    d.   Define Units that will be a Production Point.

    e.   Define Units that will be a Schedule Point.

    f.   Set the order of the Units to correspond with the flow of product through those Units on each path.

    g.   Define each potential Raw Material Input that can be fed into a Production Unit on this path.  This must be done for each Unit that is defined on an Execution Path.

    h.   For each Raw Material Input, determine if Events can be consumed on multiple Units at the same time.  If not set the Lock Materials During Consumption.  These settings override the default Unit Properties.

    i.   For each Raw Material Input, set up Bill of Material Control Filtering if required.  These settings override the default Unit Properties.

    j.   For each Raw Material Input, define the Production Units that can feed into each Input.  These Units make up the Valid Input Sources.  These settings override the default Unit Properties.

    k.   For each Raw Material Input Production Unit feed, define the Valid Input statuses that can be fed into this Input for those Units defined as Valid Input Sources to the Input.  These settings override the default Unit Properties.

    l.   Select the Products that are valid to run on a specific Execution Path.

    m.   Determine the allowable Schedule Status Transitions that can be used on a specific Execution Path.

    n.   Set the number of Schedule Statuses of a specific type to allow.

    o.   Define the Schedule Statuses that will utilize the Auto Promote feature.

    p.   Determine the Schedule Status that will be the default used for sorting in the Schedule Display.

    q.   Define the Schedule Alarm Types and Threshold Values to be used to set up alarming for tracking Schedule quantities.

    r.   Add any Customized Schedule fields that are required to be used to display, track or calculate special values for a Schedule.  These fields are User Defined Properties.

6. Build the displays to be used in Production Management for each Production Unit.

- Genealogy Display
- Schedule Display
- Production Overview Display

7. Determine which Process Variables are needed to capture and summarize data on each Production Unit.  Determine if any manually entered Variables are required to capture additional data.  Build any Calculations that combine and/or summarize data from other Variables.

# Periodic Event Dimension Update

For long production events, it may be desirable to monitor event progress during the course of an event. For example, you may want to track the quantity manufactured or other variables that control alarms.

**Control of Periodic Event Dimension Updating**

In Plant Applications 6.1.4 (April 2015), 6.2.3 (July 2015), and 6.3, a new Auto Move End Time (Minutes) configuration parameter is added to the Production Event model to automatically adjust the end time of an event, while the event is in process, and to update event dimensions. "In process" means that an event is available for consumption. Data collection is done when an event is created or the end time changes, regardless of the associated status. But now for events that have an "in-process" status, the following actions are taken:

- Data collection (updating dimensions, which may involve calculations) and updating is not done by default and only done when the Ignore Event Status flag for a variable is turned on.

- History recording is controlled by certain site parameters. A new value, History Based on Event Status, is added so that the status of the related event is checked every time a record changes.  If the Bypass History flag is selected for any Event Status, history is not recorded.

**Setting Up Periodic Event Dimension Updating**

Follow these steps using the Plant Applications Administrator to set up periodic event dimension updating:

1. In the General tab of an Edit Model screen (event configuration) for a Production Event, set the **Auto Move End Time (Minutes)** value to determine the interval at which the end time is automatically moved. The parameter tells the Event Manager to move the end time for the latest event on the unit as long as the event is "in process."  Setting the parameter to a value of "0" (zero) disables the auto-move function.

2. In the Site Parameters screen accessed from **Global Configuration**, set the Value for any of the following Site Parameters to *History Based on Event Status* for events for which you want to selectively turn off history recording through an Event Status:

    - Populate Event_Detail_History

    - Populate Event_History

    - Populate Test_History

    - Populate Waste_Event_Detail_History

3. Define or change an event status through **Administer Production Status** under **Global Configuration**, and select **Bypass Event** to stop history recording.

4. Associate production statuses (Productions Statuses tab) with a unit by right-clicking on a unit in the Plant Model and selecting **Edit <unit> Properties** to display the Properties Configuration screen for a unit. Production statuses having the **Bypass History** flag do not record history.

5. For selected variables in the Variables Sheet, accessed from a Production Unit, select the **Ignore Event Status** option to collect data for "in-process" events when using event status to turn off control data collection.

# Production Management Terminology

Production is how much was made, how much was good, how much was bad, and why it was bad.

**Work In Process (WIP)**

Work In Progress is knowing what is sitting on the production floor, where it is at on the Production Floor, what that inventory is made up of, and what it is likely to be used for.

**Traceability**

Traceability is being able to figure out "what went into making what". Focus is normally first on knowing where batches of materials were consumed, thus what finished products were affected. The

customers of a Product, internal or external, want to understand cause and effect between raw materials and finished product.

## Event Numbers

Batch ID, Lot ID, Reel ID, or any Unique Identifier for Production Events.

## Routing

Routing is controlling where a product goes, what production steps are applied to make the product, and what raw materials are consumed to make a product. Examples of Disposition or Routing of a Product are (Hold, Reject, Good, In Process, etc.) These are called Production Event Statuses.

## Dimensions

Dimensions are used to describe the size of Production Events and Orientation is used to describe the Orientation of Production Events. Examples of Dimensions for events are weight, width, length, or volume.

In Production Management, the **X dimension** is the most important. It is the primary measurement in engineering units of how much is being produced on a specific production unit. It drives the production reporting aspects of that production unit. The **Y dimension** is commonly used as length in multi-dimensional products such as paper and steel. The **Z dimension** is commonly used as width in multi-dimensional products such as paper and steel. The **A dimension** is commonly used as diameter in multi-dimensional products such as paper and steel. Each dimension has an Initial and Final value. The **Initial dimension** represents the value when the production event first was created on a unit or first reached a unit. The **Final dimension** represents the value when the production event left or was consumed on a unit. The difference in the Initial and Final dimensions could be the waste. Production Tracking is often closely tied in with Waste Tracking Configuration also.

Examples of multiple dimensional product are: Paper, Plastics, Films, Glass, Textiles, Metals

Product can be required to be ordered in more than one dimension. Proficy Schedule Tracking provides for the capability to control the schedule by more than 1 dimension and to display the setup patterns required for an Order. Products with multiple dimensions also have data related to those dimensions. Various types of data could be Profile Measurements, Defect Locations, and Test Results taken at multiple locations. Proficy is capable of handling all these associated data needs for events.

Dimensions can be acquired manually using AutoLog. The dimensions are then pushed into the appropriate dimension using calculations.

## Orientation

Spatial orientation of a product. The orientation can be important as product is moved through multiple processing steps.

## Genealogy

Genealogy is the tracking of what and how much product is used in making the other products. Genealogy provides the underlying data required for Traceability. This includes the amounts of materials used in making a Product, the routes that the Product takes, and all the steps used in making that Product.

## Genealogy Positions

Genealogy Positions are used to indicate the Item being consumed on a unit and the next item to be consumed.

- **Running Position**: Generally, means the item that is being consumed on this unit. However, it does not necessarily mean it is only unit this item is being / has been consumed on. Unloading from "Running" generally means item has been partially consumed.

- **Staged Position:** On deck or Ready to be run next. Unloading from "Staged" generally means items has not been consumed at all and is being returned to inventory.

**Event Components**

Event Components are the relationships across units between Production Events and their Dimensions

**Schedule**

A Schedule is used to track the number of different products being made with the same equipment. Orders are taken from customers for products with promised delivery dates. Production equipment must be optimally scheduled in order to accurately meet Customer Orders.

**Order**

- **Customer Order:** Placed by a customer for some amount of finished product. This could also be a Purchase Order.

- **Process Order:** Where one or more customer orders are grouped by product and assigned to a specific production equipment. These could also be called a Work Order or a Production Order.

**Production Units**

The major piece of equipment which produced (or contains) the production event.

# Production Management Client Applications

**Genealogy View Display Overview**

The Genealogy View Display is a real-time application used to load product from an input production unit or from multiple input production units on to an output or producing production unit. Raw Material Events are put into Staged and Running positions and are consumed to make new products. Relationships are created for the parent and children events.

**Uses**

- Move Input Events to the Staged and Running positions on an Output or Producing Unit

- Manually Complete an Input Event

- Manually create a new Production Event on the output of the Producing Unit

- Manually Unload an incorrect Staged Event or incorrect Running Event

- Automatic Staging, Running, Completing, and Consuming of Events based on Historian Tag values

- Filter to display only valid Input Events based on specific Production Statuses

- Filter to display only valid Input Events based on Product being created on the Producing Unit

- Modify or View Current Event Running on an Output or Producing Unit

- Review Production Event Details such as dimensions

- Provide an Overview of the Status of an Output or Producing Unit

Handling Production

- View the Family Tree for a Production Event
- Update the Production Status of a Production Event
- View the Input History for a selected Input position
- Print Labels for the selected Event
- Set up automatic label printing

**Key Data**

- Display a filtered inventory listing of all Events that are available to run on the Producing Unit
- View Autolog display data associated with the Event
- Time, Product, and Status/Routing Of Production Events
- Current Running Event on an Output or Producing Unit
- View Staged or Next Production Events to be Run
- View Production Event Details for Current Running Event, for the Staged Production Event, and for Historical Production Events on that Production Unit.
- Family Tree displays all Parent and Child Events for a selected Event
- Key performance statistics can be viewed for the Producing Unit such as: Downtime, Efficiency, Waste, Alarms, and Process Orders

**Production Overview Display**

The Production Overview Display is a real-time application used to show data specific to the performance of each Production Unit on a Line. There are four different views available for the Production Overview. They are Production Execution Path View, Units View, Alarms View, and Icons View.

**Uses**

Provide data for each Production Unit in a Production Line. The following data is available for display: the Product, Production Amount, Alarm Count, Downtime Minutes, Waste Amount, Process Order, Production Rate, Downtime Efficiency, Waste Efficiency, and the Overall Efficiency for the current production day. Double-clicking a value will also display the detail data for that value. High, Medium, and Low Alarm Counts are shown in the small boxes above the data and the fourth small box indicates if the Unit is Running or not as defined by the Downtime configuration. The Number of Downtime Events is displayed in this box for the current production day. The number of events in Inventory between Units is shown in the Inventory Box.

**Key Data**

The following data is available for display:

- Alarm Counts
- Product Code
- Process Order
- Production Rate
- Production Amount
- Production Quality
- Downtime Minutes
- Waste Amount
- Overall Efficiency

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- Detail data for each value is accessible

**Schedule View Display Overview**

The Schedule View is used to display and execute the current Production Schedule. The currently Active Process Order is used to track the Actual Quantity produced against a Process Order and its Planned Quantity, Planned Start Time and Planned End Time. The Production Schedule allows Process Orders to be reordered and edited. Process Orders can contain Setup Patterns that are specific to an individual Process Order. Setup Patterns detail the dimensions a Product is to be manufactured to for a specific order. The Schedule View can also display Customer Orders and the Order Items for a Customer Order.

**Uses**

- Provides overview of the Active Process Order

- Allow ordering or scheduling of Process Orders

- Allows editing of Process Orders

- Allows Status Changes of Process Orders

- Select the currently active Process Order which production gets counted against

- Track quantities for Process Orders

- Provide Setup Patterns to aid in manufacturing of dimensional products

**Key Data**

- Displays Planned, Actual, and Remaining Quantities for each Order

- Displays Planned Start and Planned End Time for each Order

- Lists Process Orders in Execution Order

- Provides Normal, Warning, and Alarm Indicators

# Events with Production Management

**Production Events**

Production Events are the creation of discrete units of a process and are created at various steps through the manufacturing process. Production Events are given unique names (Event Number) for a specific Production Unit used in the manufacturing of that product.

Production Events are used to identify and quantify the material that is to be created and tracked. Plants typically track multiple types of Production Events and these are used to describe how the different types of things that are made in a plant are tracked. Examples of various Production Event Types are: Batches, Lots, Reels, Rolls, Totes, Pallets, Cartons, Cases, Motors, Cars, Bricks, Bottles. For more information, see Planning Production Event or Time Tracking.

In Production Management, there are four event types that are used in dealing with Production Events as the Product represented by these Production Events is used to make other Products and thus other Production Events.

**Raw Material Movement Event**

A Movement event is an event that makes changes in position for an item running on an output or producing unit. This input item can indicate a new event (batch of raw material) is being used as an input to the product being created on an output or producing unit. It can indicate that an item has been consumed and is now completed running on the Producing Unit and it produces the required outputs for that unit.

**Genealogy Event**

Triggered when changes are made to Production Events and to the position of Production Events on Producing Units. These changes can occur manually in the Genealogy View or in AutoLog. These changes can also occur from Historian Tag value changes or Proficy Variable updates. The following tables are impacted and trigger Genealogy Events:

Table = PrdExec_Input_Event

- An Event Is Staged

- An Event Moves to the Running Position

Table = PrdExec_Input_Event_History

- An Event is Staged

- An Event Moves to the Running Position

- Event in the Running Position is Completed

- A Staged Event is Unloaded

- A Running Event is Unloaded

Table = Events

- New Event is Created

- Changes are made to an Event. For example, when the End Time of an Event is changed or if the Event Number is changed.

- Status of an Event is changed.

**Consumption Event**

Consumption Events are used to update the amount of the input events that have been consumed into the Raw Material Inputs to produce the Product on the Producing Unit. Consumption Event Models are triggered by additions to the Event_Components table for any valid source units that are defined for the Raw Material Inputs defined on the Producing Unit.

**Schedule Change Event**

A schedule change event occurs when additions, updates, or deletions are made to the production plan. These could be manual changes or changes made via an interface from an external scheduling system fed into Proficy.  The following tables are impacted and trigger Schedule Change Events when changes are made to these tables:

Table = Production_Plan

Table = Production_Setup

Table = Production_Setup_Details

Table = Production_Plan_Starts

# Planning Event Detection Models or Time Tracking

There are two ways of tracking production on a production unit. The main way is to track the creation of products using a discrete event called Production Events. The other way is using a time-based, or continuous, approach.

**Production Event Types:** Production events are the creation of discrete units of a process. Production events are created at various steps through the manufacturing process. Production events are given unique names at for a specific production unit used in the manufacturing of that product.

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Dimensions can be acquired manually using AutoLog. The dimensions are then pushed into the appropriate dimension positions using calculations.

## Planning Event Detection

The event trigger as well as event identification most often is driven by the control system. Planning for automatic event detection starts with auditing the available signals that can be used to determine when a batch has been started and stopped, what the product of the batch is, when each phase of the batch is active, when a product is used in the next production stage, and when a an input product is fully consumed. Phase information can be used to filter process data, and to trigger calculations related to a batch also.

### Data Flow for the Life Cycle of a single Production Event

There are multiple aspects to a typical Production Event. Models are used to handle the following:

- Collect Product Identification Information and Batch ID Information.
- Watch One Or More Tags To Signal Start Of Batch.
- Watch One Or More Tags To Signal Phase Changes.
- Watch One or More Tags To Set Product Being Made.
- Watch One Or More Tags To Signal End Of Batch.

Some production event models capture the product change event in-line with capturing the batch trigger. Other models simply capture a "serial number" of an item and trigger the creation of an event

of the "serial number" tag changing. Once a production event is created, calculations based on the production event are fired.

**What Type of Events can be Automated?**

- Batch and Phase Triggers
- Batch, Lot Identification
- Product Identification
- Production Event Status and Disposition
- Product Movement and Routing
- Collection of Process Data From Control Systems
- Process and Batch Recipes

**Examples of Automatic Events**

- Recipe Downloaded to Batch Execution System At Batch Start
- Batch Execution System Triggers Phase and Batch End
- Batch Data and Control System Data Summarized By Batch, Phase
- Disposition Automatically Set by Control System Data

**Guide to Preparing The Control System For Automatic Batch Detection**

1. Establish the "rule" that defines when an event has started or stopped.
2. Establish the "rule" that defines the product code of the event.
3. Determine the behavior of the available signals. Do they pulse or hold value? When does the product code change relative to the event start or end? How is phase indicated and when does it change?
4. Where timing is critical, supplemental logic in the control system can be built to latch in trigger values, or control the sequencing of events firing to give event models enough chance to recognize the event and collect data around that event.
5. Collect all signals into the historian at the appropriate resolution.

**Issues with Tracking of Discrete Production**

What is the smallest discrete entity that exists?

- That can be uniquely identified
- Exists for a discrete period of time on a unit or has discrete boundaries

How is that entity identified?

- Manually
- Automatically from tags in the Historian
- From scanning barcodes

How is size of that entity described?

- Weight, Length, Width, Count
- Potentially multiple dimensions…

How do these entities move through the process?

- What are the potential paths for these events through the various units of production?

**Issues with Tracking Continuous Production**

- Tracking continuous production will not allow for genealogy tracking unless you create pseudo Lots or Events to simulate for tracking against if that is necessary.

- Typically used for Simplest of Processes to do Production Reporting and Schedule Integration.

- Totalization or counting of manual entries or Historian data.

- Finding or creating what signals are available such as PLC Counters and Flow signals.

**Which Clients Can Manipulate Production Management Data?**

- Genealogy View Display

  o Stage the Next Product's Production Events or Events from Input Units on to an Output or Producing Unit.
  o Change Production Event Disposition
  o Modify or View Current Event Running on an Output or Producing Unit.
  o View Production Event Details.
  o Change Disposition Status of a Production Event.

- Production Overview Display

  o View Key Production Summary Data for each Production Unit in a Production Line

- Schedule View Display

  o Provide overview of the status of the current Process Order being run.
  o Allow ordering and editing of Process Orders.
  o Select the currently active Process Order which production gets counted against.
  o The Schedule View can display Setup Patterns that are specific to an individual Process Order. Setup Patterns detail the dimensions a Product is to be manufactured to for a specific order.
  o The Schedule View can display Customer Orders and the Order Items for a Customer Order.

# Modeling Product Flow

**Planning for Control Points, Statuses, Disposition Decisions, and Product Routing**

When planning the configuration of product flow and the routing required to build products, the following questions must be answered:

- What discrete pieces of equipment are involved?

- How is equipment arranged into lines or departments?

- What are the potential paths of product and type of product that can move between pieces of equipment?

- What are the specific paths that each product can take?

- What paths will be controlled by a schedule?

- What are the production counting points for each path?

- What triggers movement of material to the next step of manufacturing?

- What prevents movement of material to the next step of manufacturing?

The spots in the process where a disposition decision is made are known as control points and are configured as production units within the plant model. Control points may represent physical pieces of

equipment or may be a logical point in the process where quality decisions must be made. There are several questions to consider when setting up logic for control points.

To model the product flow, the execution path and the control points are configured by:

- Defining where production counting and production tracking against a schedule will be set up.

- Defining the potential paths that all products can take through a production line.

- Defining production units that are valid processing steps for each path. Production units that are valid processing steps are the units that a product will flow through during the manufacturing of that product on a particular production line. A valid unit is one that will have production events created for it and these events will be linked to events in the previous unit and to events in the unit that follows.

- Determining the order of production units and the potential input sources to each production unit. Input sources are the production units, and the items or events they produce, that are used as an input to the raw material Inputs that have been defined on a production unit.

  Valid input statuses allow for the filtering of input events to a producing unit by specific production statuses. It is set up on a production unit such that when it is required to stage or load a new product in the Genealogy View, the list of events available for selection is limited to events of a certain production status. The appropriate event can then be selected from that list to make the new product on the output or producing production unit.

- Determining the potential paths and the valid processing steps across units. Production units that are valid processing steps are the units that a product will flow through during the manufacturing of that product on a particular production line. A valid unit is one that will have production events created for it and these events will be linked to events in the previous unit and to events in the unit that follows.

- Determining which statuses should allow production to continue on. Many processes require that a "disposition" decision be made for each item produced. The disposition decision may involve simply accepting or rejecting a batch or lot, or it may also involve changing the "routing," or path the product will take through the plant.

  In the process of dispositioning, where the decisions will be made are known as "control points" and are configured as production units within the plant model. Control points may represent physical pieces of equipment, or may simply be a logical point in the process where quality decisions must be made.

- Planning for the control points, production event statuses, and disposition decisions. There are several questions to consider when setting up logic for "control points."

  o **Do you want manual or automatic disposition?** Manual disposition can be achieved from a variety of clients by simply changing the status of a product event. Automatic disposition can be driven by the disposition model defined by the production event properties on a given unit. For more information, see the topic, "Model 1054-Disposition Model" in the online help.

  o **Which variables can affect disposition?** Any variable, whether manually entered or calculated, may have specification limits and, therefore, may affect disposition. The general strategy to associate certain variables with the disposition decision is to make sure those variables have reject limits defined as part of the product specification. Any variables that do not affect disposition should not have reject limits defined.

  o **Who needs to be aware of a disposition change?** Whenever a disposition event occurs, the status of the production event changes and will be automatically updated on any displays where that production event is shown. In addition, the disposition event may trigger alarms and calculations. These alarms and calculations may be on the unit where the disposition event occurred, or may be on upstream or downstream units. This provides a variety of ways to highlight an issue with product that may need to be dealt with upstream or downstream in the process. Changing the disposition may also affect how production events can be routed through the process. Each unit has one or more "inputs" defined. For

each input, the "legal" statuses available to move into the Input are defined. Through this configuration, rejected statuses can be prevented from moving further in the process. Likewise, this may be used to prevent the movement of production events before a disposition event occurs.

o **What is the upstream and downstream effect of disposition?** As discussed above, changing the status of a production event can affect its potential paths through the process. The case that is potentially more important to consider is, what should happen when the disposition is changed after a production event has already moved forward in the process. Sometimes the output of the next unit in line needs to be automatically rejected, other times the process may need to be shut down. Both can be achieved through alarms and calculations. Specifically, a type of calculation known as a "genealogy calculation" may be employed. Genealogy calculations model genealogy to perform calculations that cross units. Through a genealogy calculation, changes in the data or the status of a production event can fire calculations upstream and downstream in the process, which can in-turn provide alarming or automatic disposition at that point in the process.

# Utilizing Calculations

**Reasons for calculations in Production Management**

- Combine manual / automatic variables

- Drive disposition, or alarm conditions

- Summarize variables into key performance measures

- Implement site specific logic for triggering events

There are three key attributes of a calculation, the "Event Type," the "Sampling Type," and the "Sampling Interval." The Event Type defines which type of Proficy Event drives the calculation, when is the calculation triggered and what is the time scope of the calculation. For example, a calculation with Event Type = Production Event will be triggered any time a Production Event is created or updated on a Production Unit. The time scope of the calculation will be between the start time and the end time of the Production Event.

The Sampling Interval applies only to Time Based variables. Event Based variables inherit their time scope from the event they are derived from, and Time-Based variables must have it explicitly defined. The Sampling Interval is specified in minutes.

The Sampling Type defines how data is transformed or aggregated from its raw form. Simple examples of Sampling Type include "Average," "Standard Deviation," and "Total." More complex examples of Sampling Types include "%Limit" or the percentage of time a variable was controlled within its Reject limits, or "Raw Count" which is the count of values found over a time period.

There are two types of calculation definitions, ones that use the predefined sampling types (which typically aggregate or summarize data), and User Defined Calculations. User defined calculations allow almost unlimited capability to create new sampling logic.

**Predefined Calculations (sampling types)**

- Sampling – Last Good Value, Next Good Value, Interpolated

- Simple Aggregation - Avg, Std, Min, Max, Total

- Complex Aggregation – Raw Count, Unique Count, Raw Average, Total, Min, Max

- Specification Based – Cpk, Cp, Ppk, Pp, %Warning, %Limit

- Other – Last Event Time, Increase

For detailed information on sampling types, see Variable Product Definitions.

**User Defined Calculations**

Handling Production

Within a User Defined Calculation, three things must be defined. The calculation logic, the calculation inputs, and calculation dependencies. Calculation dependencies are factors (or variables) that should trigger the calculation or recalculation of a result.

**Ways of Defining Calculation Logic**

- Simple Calculations

- Complex VBScript Calculations

- Stored Procedure Calculations

**Inputs to Calculations**

- Current Value of Variable

- Previous or Next Value Of Variable

- Attributes of A Variable

- Specifications / Recipe Parameter For Variable

- Attributes of Event

- Attributes of Unit

**Dependencies of Calculations**

- Natural Dependency – Event Created / Updated, TimePeriodPasses

- Variable Dependency – Component Of Calculation Changes

- Forced Dependency – Additional Dependent Variable Changes

Data from a calculation is either returned as a single result, or for stored procedure type calculations can additionally be returned in the form of a custom formatted SQL result set that the calling Proficy Service can interpret. These defined Result sets can be used to return results for several variables at a time, or may be used to trigger additional events.

# Production Event Status

Production statuses are used to indicate the current status of a Production Event or User-Defined Event and are set up through the Production Status Editor. Refer to Production Statuses and Events.

**Production Management Internal Statuses**

Production Management includes four internal statuses to indicate the following conditions:

- An event is not in a state that requires the data gathering facilities to be engaged.

  For example, data does not have to be gathered for Historian values, schedule tests or repeat values.

- A status is in the process of changing.

  For example, if a status changes from Complete to Inventory there would be no need to gather Historian data.

The four internal statuses are:

- NoId-Staged

- NoId-Running

- Staged

- Running

  ***Important:*** *Do not make any changes to these statuses. Create new statuses to accommodate any custom requirements that your system may have.*